Implications of orbital multi-angle photopolarimetric observations in the 1.378-μm spectral channel to retrieve microphysical properties and composition of stratospheric aerosols of natural or artificial origin

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We discuss the virtues of orbital photopolarimetric measurements within a narrow spectral channel centered at 1.378 μm to retrieve microphysical characteristics and chemical composition of stratospheric aerosols separately from those of tropospheric aerosols. We are motivated by the fact that at this wavelength, the water vapor in the troposphere can absorb the sunlight scattered by clouds, tropospheric aerosols, and the surface almost completely. We use numerically exact solutions of the vector radiative transfer equation to theoretically simulate measurements carried out for various numbers of scattering angles, including: (i) radiance measurements alone; (ii) polarization measurements alone; and (iii) radiance and polarization measurements in concert. We consider the cases of stratospheric aerosols caused by volcanic eruptions or human geoengineering activities and adopt the model of the stratosphere in the form of a homogeneous plane-parallel layer composed of polydisperse spherical particles. We show that it is only the simultaneous use of radiance as well as polarization measurements at a sufficiently large number of scattering angles that enables one to retrieve the optical thickness, effective radius, and refractive index of stratospheric aerosols with adequate accuracy.

Preferred mode of presentation: Oral